CLAIMS

1. A spark ignition engine, comprising:

combustion control means for controlling ignition timing by an ignition plug; and

turbulence generating means for generating turbulence in an exhaust flow in an exhaust passage, wherein:

the combustion control means makes ignition timing immediately before a compression stroke top dead center or later in the case where the temperature of the engine is lower than the predetermined temperature.

2. A spark ignition engine according to Claim 1, comprising:

fuel stratifying means for stratifying fuel in a combustion chamber, wherein:

the combustion control means instructs the fuel stratifying means to layer fuel in the combustion chamber in the case where the temperature of the engine is lower than the predetermined temperature.

3. A spark ignition engine according to Claim 1, comprising:

a fuel injection valve for directly injecting fuel into the combustion chamber, wherein:

the combustion control means instructs the fuel injection valve to inject fuel at a compression stroke in the case where the temperature of the engine is lower than the predetermined temperature.

4. A spark ignition engine, comprising:

turbulence generating means for generating turbulence in an exhaust flow in an exhaust passage;

a fuel injection valve for directly injecting fuel into a combustion chamber; and

fuel injection control means for controlling fuel injection timing by the fuel injection valve, wherein:

the fuel injection control means instructs the fuel injection valve to inject fuel at an expansion stroke in the case where the temperature of the engine is lower than the predetermined temperature.

5. A spark ignition engine, comprising:

ignition timing control means for controlling ignition timing by an ignition plug;

a fuel injection valve for directly injecting fuel into a combustion chamber; and

fuel injection control means for controlling fuel injection timing by the fuel injection valve, wherein:

the penetration of fuel spray injected from the fuel injection valve in the direction of an ignition plug is made longer than that in the direction of a piston;

in the case where the temperature of the engine is lower than the predetermined temperature, the fuel injection control means instructs the fuel injection valve to inject fuel in the second half of a compression stroke so that the air-fuel ratio is in the vicinity of the theoretical air-fuel ratio; and

the ignition timing control means makes ignition timing immediately before a compression stroke top dead center or later.

6. A spark ignition engine, comprising:

ignition timing control means for controlling ignition timing by an ignition plug;

a fuel injection valve for directly injecting fuel into a combustion chamber;

fuel injection control means for controlling fuel injection timing by the fuel injection valve; and

longitudinal vortex generating means for generating a forward longitudinal vortex in a combustion chamber, wherein:

in the case where the temperature of the engine is lower than the predetermined temperature, the longitudinal vortex generating means generates a forward longitudinal vortex in the combustion chamber;

the fuel injection control means instructs the fuel injection valve to inject fuel in the second half of a compression stroke so that the air-fuel ratio is in the vicinity of the theoretical air-fuel ratio; and

the ignition timing control means makes ignition timing immediately before a compression stroke top dead center or later.

7. A spark ignition engine, comprising:

ignition timing control means for controlling ignition timing by an ignition plug;

a fuel injection valve for directly injecting fuel into a combustion chamber;

fuel injection control means for controlling fuel injection timing by the fuel injection valve; and

longitudinal vortex generating means for generating a forward longitudinal vortex in the combustion chamber, wherein:

the penetration of fuel spray injected from the fuel injection valve in the direction of an ignition plug is made longer than that in the direction of a piston;

in the case where the temperature of the engine is lower than the predetermined temperature, the longitudinal vortex generating means generates a forward longitudinal vortex in the combustion chamber;

the fuel injection control means instructs the fuel injection valve to inject fuel in the second half of a compression stroke so that the air-fuel ratio is in the vicinity of the theoretical air-fuel ratio; and

the ignition timing control means makes ignition timing immediately before a compression stroke top dead center or later.

8. A spark ignition engine according to Claim 6, comprising:

longitudinal vortex controlling means for controlling the strength of a forward longitudinal vortex generated in the combustion chamber; and

fluctuation detecting means for detecting the magnitude of the fluctuation of engine speed or torque fluctuation, wherein:

the longitudinal vortex controlling means controls the strength of the longitudinal vortex so that the magnitude of the fluctuation of engine speed or torque fluctuation is a predetermined value or less; and

the ignition timing control means delays ignition timing to the extent possible.

9. A spark ignition engine according to Claim 7, comprising:

longitudinal vortex controlling means for controlling the strength of a forward longitudinal vortex generated in the combustion chamber; and

fluctuation detecting means for detecting the magnitude of the fluctuation of engine speed or torque fluctuation, wherein:

the longitudinal vortex controlling means controls the strength of the longitudinal vortex so that the magnitude of the fluctuation of engine speed or torque fluctuation is a predetermined value or less; and

the ignition timing control means delays ignition timing to the extent possible.

10. A spark ignition engine, comprising:

ignition timing control means for controlling ignition timing by an ignition plug;

a fuel injection valve for directly injecting fuel into a combustion chamber;

fuel injection control means for controlling fuel injection timing by the fuel injection valve;

fuel pressure controlling means for controlling the pressure of fuel supplied to the fuel injection valve; and

fluctuation detecting means for detecting the magnitude of the fluctuation of engine speed or torque fluctuation, wherein:

in the case where the temperature of the engine is lower than the predetermined temperature, the fuel injection control means instructs the fuel injection valve to inject fuel in the second half of a compression stroke so that the air-fuel ratio is in the vicinity of the theoretical air-fuel ratio;

the fuel pressure controlling means controls fuel pressure so that the magnitude of the fluctuation of engine speed or torque fluctuation is a predetermined value or less; and

the ignition timing control means delays ignition timing to the extent possible.

11. A spark ignition engine according to Claim 3, wherein:

time interval between the latest fuel injection initiation timing and ignition initiation timing is 9 ms or longer.

12. A spark ignition engine according to Claim 5, comprising:

turbulence generating means for generating turbulence in an exhaust flow in the exhaust passage.

13. A spark ignition engine according to Claim 1, comprising:

a fuel injection valve for injecting fuel into an intake port, wherein:

said combustion control means instructs the fuel injection valve to inject fuel at an intake stroke in the case where the temperature of the engine is lower than the predetermined temperature.

14. A spark ignition engine according to Claim 1, wherein:

said turbulence generating means is mounted in an exhaust passage at the position where the exhaust temperature in warming-up operation is 600°C or higher.

15. A spark ignition engine according to Claim 1, wherein:

said turbulence generating means is mounted in an exhaust passage at the position which is within 500 mm downstream from the most upstream part of the exhaust passage.

16. A spark ignition engine according to Claim 1, wherein:

the cross-sectional area of an exhaust passage in the vicinity of said turbulence generating means mounted therein, is made larger than at least the cross-sectional area of upstream part of the passage.

17. A spark ignition engine according to Claim 1, wherein:

said turbulence generating means is configured by plural rods or plural plates arranged in parallel so that they cross the exhaust passage.

18. A spark ignition engine according to Claim 1, wherein:

said turbulence generating means is configured in the form of a grid or a cobweb.

19. A spark ignition engine according to Claim 17, wherein:

the interval between component members of said turbulence generating means is narrower on the wall side, as compared with that in the center of the exhaust passage.

20. A spark ignition engine according to Claim 1, wherein:

said turbulence generating means is configured by plural projections or annular members protruded inwardly from an inner wall of the exhaust passage.

21. A spark ignition engine according to Claim 1, wherein:

said turbulence generating means is configured by a step mounted on an inner wall of the exhaust passage.

22. A spark ignition engine according to Claim 17, wherein:

said turbulence generating means is integrated with a gasket arranged between the exhaust passage and a cylinder head.

23. A spark ignition engine according to Claim 17, wherein:

said turbulence generating means is held between or positioned adjacently to gaskets arranged between the exhaust passage and a cylinder head.

24. A spark ignition engine according to Claim 17, wherein:

said turbulence generating means can be electrically heated.

25. A spark ignition engine according to Claim 17, wherein:

said turbulence generating means is arranged so that the width of the component member is Rec · v/Ue or more, where Rec is the critical Reynolds number at which a Karman vortex is generated, Ue is the mean exhaust velocity in the exhaust passage in warming-up operation and v is the kinematic coefficient of viscosity of exhaust gas.

26. A combustion control method of a spark ignition engine, which generates turbulence in an exhaust flow in an exhaust passage, and makes ignition timing immediately before a compression stroke top dead center or later in the case where the temperature of the engine is lower than the predetermined temperature,.

27. A combustion control method according to Claim 26, which

in the case where the temperature of the engine is lower than the predetermined temperature, makes fuel stratified in a combustion chamber.

28. A combustion control method according to Claim 26, which in the case where the temperature of the engine is lower than the predetermined temperature, injects fuel in a compression stroke.

29. A combustion control method of a spark ignition engine, which generates turbulence in an exhaust flow in an exhaust passage; and injects fuel directly into a combustion chamber; and
in the case where the temperature of the engine is lower than the predetermined temperature, inject fuel in an expansion stroke.

30. A combustion control method of a spark ignition engine, which makes penetration of injected fuel spray in the direction of an ignition plug longer than that in the direction of a piston; and
in the case where the temperature of the engine is lower than the predetermined temperature, injects fuel in the second half of a compression stroke so that the air-fuel ratio is in the vicinity of the theoretical air-fuel ratio; and
makes ignition timing immediately before a compression stroke top dead center or later.

31. A combustion control method of a spark ignition engine, which:
in the case where the temperature of the engine is lower than the predetermined temperature, generates a forward longitudinal vortex in a combustion chamber;
injects fuel in the second half of a compression stroke so that the air-fuel ratio is in the vicinity of the theoretical air-fuel ratio; and
makes ignition timing immediately before a compression stroke top dead center or later.

32. A combustion control method of a spark ignition engine, which :
makes penetration of injected fuel spray in the direction of an ignition plug longer than that in the direction of a piston;
in the case where the temperature of the engine is lower than the predetermined temperature, generates a forward longitudinal vortex in a combustion chamber;
injects fuel in the second half of a compression stroke so that the air-fuel ratio is in the vicinity of the theoretical air-fuel ratio; and
makes ignition timing immediately before or later a compression stroke top dead center.

33. A combustion control method according to Claim 31, which :
regulates the strength of a forward longitudinal vortex generated in the combustion chamber so that the magnitude of the fluctuation of engine speed or torque fluctuation is a predetermined value or less; and
delays ignition timing to the extent possible.

34. A combustion control method of a spark ignition engine, which:
in the case where the temperature of the engine is lower than the predetermined temperature, injects fuel in the second half of a compression stroke so that the air-fuel ratio is in the vicinity of the theoretical air-fuel ratio;
regulates the injection pressure of fuel so that the magnitude of the fluctuation of engine speed or torque fluctuation is a predetermined value or less; and
delays ignition timing to the extent possible.

35. A combustion control method according to Claim 28, which:
sets time interval between the latest fuel injection initiation timing and the ignition initiation timing to 9 ms or more.

36. A combustion control method according to Claim 26, which:

injects fuel into an intake port; and

in the case where the temperature of the engine is lower than the predetermined temperature, injects fuel in an intake stroke.